

Remarks

Claims 1-4 and 6-15 were pending in the application. Claims 8 and 9 are withdrawn from consideration. In the Office Action mailed July 22, 2010, claims 1-4, 6, 7 and 10-15 are rejected. In the instant Amendment, claim 1-4 and 6-15 have been amended to address minor informalities. Claim 2 has been further amended to recite at least one of V, Ti and Nb. Support for this amendment is found throughout the specification, e.g., page 10, lines 21-23 and Table 1, e.g., steels 23, 25, 27. New claims 16-18 have been added. Support for the new claim 16 is found throughout the specification, e.g., Table 1, steel 26. Support for new claims 17 and 18 is found throughout the specification, e.g., page 10, lines 21-23 and Table 1, e.g., steels 23, 25, 27.

By the present amendment, claims 1-4 and 6-18 will be pending in the application. No new matter has been added by the amendments. Entry of the foregoing amendments and consideration of the following remarks are respectfully requested.

Claim Rejections under 35 U.S.C. § 103(a)

Claims 1-4, 6, 7 and 10-15 are rejected under 35 U.S.C. § 103, as being unpatentable over the European patent 1154028 to Vrieze (“EP'028”) alone or in view of Japanese patent 2003-105513 (“JP'513”).

The present invention is directed to a high strength steel sheet excellent in formability and resistant to delayed fracture, compatible with a chemical conversion coating treatment and hot-dip galvanizing, the steel being composed of the claimed composition including: 0.107 to 0.3% Si, and 0.2 to 1.2% Al, wherein the amounts of Si and Al are controlled according to equation (1) and the metallographic structure of said steel sheet contains ferrite and martensite without containing retained austenite and has a tensile strength of 980 MPa or more and a value of TS x El of 16,000 or more.

The Examiner states that EP'028 claims 1 to 6 disclose a high strength steel sheet composition having constituents whose wt% ranges overlap or closely approximate those recited by the claims. The Examiner points to EP'028 claim 4 for teaching ferrite and at least 15% of hardening structures of martensite, residual austenite and/or bainite, specifically at most 50% martensite and/or bainite and at most 10% residual austenite, and optionally at most 5-10% pearlite which would allegedly suggest the presently claimed microstructure

containing ferrite and martensite without containing retained austenite. It is the Examiner's opinion that EP'028 teaches residual austenite, bainite and bainite as optional and therefore can be omitted. In regard to the steel properties, the Examiner further states that EP'028 in claims 5 and 6 teaches tensile strength ("TS") of 600-1100 MPa and TS x EI = 12,000-25,000 MPa% that would overlap and allegedly teach the presently claimed TS of 980 MPa or more and TS x EL of 16,000 or more, respectively.

In contrast to the Examiner's contentions, the EP'028 steel compositions does not overlap or closely approximate the presently claimed composition. For example, EP'028 requires greater amount of Si (claim 1: 0.35- 0.5%; exemplified: 0.376-0.818%). In contrast, the present inventors note that when Si is added in an excess of 0.3% the chemical conversion coating treatment and hot-dip galvanization deteriorates. See, specification at p. 7, ll. 26-30 and Tables 1 and 2.

Also, EP'028 requires minimizing Mn (claim 1: 1.35-1.8%; exemplified: 1.503 – 1.764%) in order to achieve satisfactory surface qualities according to the EP'028 technology. Additional alloying elements are required to improve the tensile strength and elongation properties of the steel. Specifically, EP'028 states that:

[i]n the multiphase steel according to the invention, the most important alloying element (other than carbon) is not molybdenum or chromium, but rather manganese. To prevent a poor surface quality, the quantity of manganese in the steel is no higher than 1.8%, which is too low to suppress pearlite under the cooling conditions encountered in many immersion galvanization lines. Therefore small quantities of elements such as P, Al, Nb, V, Ti, B and N have been added.

EP'028, page 3, ¶ [0013].

With respect to the type of steel composition described by EP'028, the present specification states that:

[i]n general, large amounts of alloying elements must be added in order to produce a steel sheet having a high strength and in which the formation of ferrite is suppressed. For that reason, the fraction of ferrite in a structure decreases, the fraction of the second phase increases, and therefore elongation decreases considerably particularly in a DP steel of 980 MPa or more. To cope with this, the measures of the addition of Si and the reduction of Mn are mostly taken. However, the former

measure causes the performance of chemical conversion treatment and hot-dip galvanization to deteriorate, the latter measure causes a strength to be hard to secure and, therefore, these measures are not usable for a steel sheet as intended in the present invention. In this light, the present inventors, as a result of intensive studies, found that when the amounts of Al, Si and the value of TS were controlled so as to satisfy the following expression (1), a sufficient ferrite fraction was secured and an excellent elongation was secured; $(0.0012 \cdot \text{target strength TS} - 0.29 - [\text{Si}]) / 2.45 < \text{Al} < 1.5 - 3 \cdot [\text{Si}]$ (1) where [target strength TS] was the designed strength of the steel sheet in terms of MPa and [Si] was the amount of Si in terms of mass %.

Specification, page 9, lines 3-21, emphasis added. Thus, EP'028 is concerned with a conventional steel with the problems discussed above. In contrast, the present invention controls the amounts of Al *and* Si and is able to achieve a high tensile strength steel compatible with chemical conversion treatment and hot-dip galvanizing while maintaining excellent elongation at lower Si, without restricting Mn and without requiring the addition of extra alloying elements.

Although EP'028 broadly recites Al in an amount from 0.05 – 0.5%, only steels having Al less than 0.089 are exemplified. In contrast, the present inventors note that “an Al addition of 0.2% or more is necessary for the improvement of ductility.” Specification, page 8, lines 25-27.

Moreover, EP'028 does not even disclose or suggest a single steel sheet having the required TS of 980 MPa or more. Although EP'028 broadly discloses that “preferably, the steel has a tensile strength of 600-1100 MPa” (EP'028 at ¶ [0028]) and that “the steel preferably has a value of the product of tensile strength times total elongation (A80) of from 12,000-25,000 MPa%” (EP'028 ¶ [0029]), the greatest tensile strength achieved by the EP'028 technology is steel C which achieves 863 MPa but requires an elevated amount of Si (0.516%), reduced amounts of Mn (1.764%), reduced amounts of Al (0.089%); a composition clearly outside the scope of the present invention. Thus, based on the EP'028 disclosure, a person of ordinary skill in the art would not expect to achieve a tensile strength greater than 980 MPa having high elongation and excellent compatibility with chemical conversion treatment and hot-dip galvanizing with the EP'028 composition since all the EP'028 steels have a tensile strength of 863 MPa or less.

The Examiner has pointed to JP'513 for disclosing steel including 0.005 to 0.005% Ca and 0.0005 to 0.005% REM. See, office action at page 5. However, JP'513 does not disclose or suggest a steel having the claimed composition providing a tensile strength greater than 980 MPa. JP'513 does not supply what is missing from EP'028.

Therefore, EP'028 does not render the claimed invention obvious, either alone or in combination with JP'513, for at least the above reasons. Applicants respectfully request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103 of claims 1-4, 6, 7 and 10-15 in view of the EP'028 disclosure either alone or in combination with JP'513. Further, applicants respectfully request that claims 8 and 9 be rejoined to the application and found allowable.

Conclusion

In view of the foregoing amendments and remarks, Applicants respectfully submit that the present application is in condition for allowance. Early and favorable action by the Examiner is earnestly solicited. If the Examiner believes that issues may be resolved by a telephone interview, the Examiner is invited to telephone the undersigned at the number below.

Respectfully Submitted,

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